REMARKS

In response to the above Office Action, claim 1 has been amended to more specifically define applicants' invention and distinguish it from the cited prior art.

Claim 1 now recites the range of amounts of the four components of the catalyst. Support for the range of component (1) can be found in claim 2. Support for the range of component (2) can be found in claim 5. Support for the range of component (3) can be found in claim 9. Support for the lower value of the range of component (4), i.e., 0.03, can be found in Examples 1 and 2 in Table 1 on page 14 of the specification and for the upper value, i.e., 5%, can be found in claim 10. Finally, support for the addition of Cd to the group of elements of component (2) can be found on page 6, line 22 of the specification. As a result of the amendments to claim 1, claims 2, 5, and 7-10 have been cancelled and claim 11 amended to be consistent with amended claim 1.

Claim 17 has been amended to recite proper Markush language and claims 19-22 for clarity. Finally, claims 23 and 24 have been amended to positively recite a process step. New claim 25 is similar to claims 23 and 24, but dependent from claim 16.

In addition, Table 4 on page 20 has been amended to correct an obvious typographical error and the Abstract to comply with M.P.E.P. §608.01(b).

In the Office Action, the Examiner rejected claims 1-24 under 35 U.S.C. §103(a) for being obvious over WO 98/26867. For convenience, in the discussion of this document, reference will be made to its English equivalent, U.S. Patent No. 6,228,800 to Yamaguchi et al. (hereafter Yamaguchi).

As set forth in amended claim 1, the present invention relates to a selective hydrogenation catalyst for selectively hydrogenating an unsaturated hydrocarbon, which

comprises the following active components loaded on a porous inorganic support based on the total weight of catalyst:

(1) 0.001 - 1% of at least one element selected from the group consisting of Pt, Pd, Ni, Ru, Co, and Rh;

(2) 0.001 - 10% of at least one element selected from the group consisting of Ag, Cu, Zn, K, Na, Mg, Ca, Be, Sn, Pb, Sr, Ba, Cd, Ra, Fe, Mn, Zr, Mo, and Ge;

(3) 0.1 - 1.5% of at least one of a rare earth metal; and

(4) 0.03 - 5% of Bi;

wherein the rare earth metal is selected from the group consisting of Sc, Y, and Lanthanides in Group IIIB of the periodic table of elements.

It was found, as discussed in further detail below, that the catalyst was able to hydrogenate high-unsaturated hydrocarbons such as an alkyne with high selectivity while minimizing green oil formation and deposits on the catalyst.

Yamaguchi relates to a noble metal supported article where the distribution of palladium in the article is controlled. While the reference discloses that the catalyst can be used for the hydrogenation of unsaturated hydrocarbons (column 13, lines 30-33) and can include, on an inorganic support, (column 6, lines 66-67), in addition to the palladium, silver, copper, zinc or lead (column 12, lines 21-32) or an alkali metal or alkaline earth metal (column 3, lines 55-56 and column 6, lines 65-66); a rare earth metal (column 3, line 56 and column 6, line 66); and bismuth (column 3, line 50 and column 12, line 24), the reference does not specifically teach a catalyst comprising all four active components claimed nor the claimed weight percent ranges of these

components in one catalyst. In fact, as noted by the Examiner on page 3 of the Office Action, the amounts of metals in the catalyst of Yamaguchi are not critical.

In contrast as set forth in amended claim 1, the present invention not only defines the four active components that constitute the catalyst for selective hydrogenation, but also defines the amounts of the active components. Such a catalyst has unexpected technical advantages in comparison with both a catalyst that lacks one or more of the components and a catalyst in which the amounts of components are outside of the claimed ranges. There is nothing in Yamaguchi that teaches or suggests this combination of components and ranges of amounts thereof.

With reference to Table 1 on page 14 of the specification, both acetylene conversion and ethylene selectivity of the catalyst of Pd-La-Ag-Bi (Example 1) or the catalyst of Pd-La-Ag-K-Bi (Example 2), in which the amounts of active components are within the ranges as defined in amended claim 1, are higher than that of a catalyst that lacks a rare earth metal (Comparative Example 1) or a catalyst that lacks bismuth (Comparative Example 2). Regarding Example 3 in Table 1, these amounts of rare earth metal and bismuth in the catalyst are not within the ranges claimed in amended claim 1, and the acetylene conversion and ethylene selectivity are not notably improved.

Clearly there is not any teaching in Yamaguchi that these benefits would result from the specific catalyst of amended claim 1 when used for the hydrogenation of unsaturated hydrocarbons.

In addition and with reference to Table 2 on page 18 of the specification, when a rare earth metal component is present, the ethylene selectivity of the catalysts of Examples 4 and 5 (in which the amounts of the components are within the ranges as

defined in amended claim 1) increases more than 10% under a relatively high space velocity (10,000 hr^{-1}) compared with that of the catalyst of Comparative Example 4 that lacks a rare earth metal component. Thus the effect of the rare earth metal component in the catalyst is significant.

Since rare earth elements can stabilize the property of a catalyst, they may inhibit its activity to some extent. Thus, the ethylene selectivity of the catalyst of Example 7 that contains a relatively high amount of rare earth metal (i.e., more than the amount set forth in amended claim 1) decreases to some extent the selectivity when the outlet acetylene is less than 1 ppm.

Moreover, and with reference to Table 3 on page 19 of the specification, because of the addition of critical amounts of rare earth metal and bismuth, the catalyst of the present invention effectively reduces the amount of generated green oil and the amount of green oil that adheres to the catalyst.

In summary, the claimed catalyst when used for the hydrogenation of unsaturated hydrocarbons, not only has increased activity and selectivity, but reduces green oil formation and green oil deposition, resulting in a catalyst having an increased service period and life. None of this could have been predicted based on the teachings of Yamaguchi.

As noted by the court in Uniroyal, Inc. v. Rudkin-Wiley Corp., 837 F.2d 1044, 5 U.S.P.Q. 2d 1434 (Fed. Cir. 1988)

> Something in the prior art as a whole must suggest the desirability, and thus the obviousness, of making the combination [837 F.2d at 1051, 5 U.S.P.Q. 2d at 1438, citing Lindemann, 730 F.2d 1452, 1462, 221 U.S.P.Q. 481, 488 (Fed. Cir 1984).]

Where is the "desirability" suggested in Yamaguchi of making the claimed combination of elements and their respective amounts? If the claimed combination when used as a catalyst had no significant effect on the acetylene conversion and ethylene selectivity compared to a catalyst outside of the claimed combination, the claimed combination might well be considered obvious, but when the combination results in unexpected and superior results, it cannot be considered obvious. As noted by the court in In re Dow Chemical Co., 837 F.2d 469, 5 U.S.P.Q. 2d 1529 (Fed. Cir. 1988) "both the suggestion of the invention and the expectation of its success must be found in the prior art" (emphasis added). See also M.P.E.P. §716.02(a).

It is believed claims 1, 3, 4, 6, and 11-25 are in condition for allowance.

In view of the foregoing amendments and remarks, Applicants respectfully request reconsideration and reexamination of this application and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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By: _____
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Attachments: **Replacement Abstract**

Abstract

~~This invention relates to a~~ A selective hydrogenation catalyst for the ~~seletive~~ selective hydrogenation of unsaturated hydrocarbons, a process for preparing this catalyst and its use. The catalyst of the invention comprises ~~supporter~~ a support, active component Pd, rare earth metals, and auxiliary metal Bi, Ag etc. The catalyst is able to hydrogenate high-unsaturated hydrocarbons such as alkyne with high selectivity at high space velocity while both green oil formation and carbon deposition on the catalyst are very low~~, and it~~. It is **[[**very**]]** applicable to an industrial cracking process.